UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Summary Review of Monthly Reports*
for
SOIL CONSERVATION SERVICE RESEARCH**
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EROSION CONTROL PRACTICES DIVISION

Values of Winter Cover Crops - O. R. Neal, New Brunswick, New Jersey.-"The value of winter cover crops in reducing soil and water losses has been shown in numerous cases. The conservation effectiveness is not limited to the winter period but extends throughout the cultivation season. In an experiment carried out at the Marlboro station some years ago the annual use of rye cover crops, as compared with untreated areas, reduced yearly soil loss by 42 percent and water loss by 13 percent. During growing seasons when areas from both treatments were under identical cultivation conditions, areas which had had winter cover lost 30 percent less soil and 23 percent less water than did areas that were bare over the winter seasons.

"Since cover crops have been found to be an effective conservation practice, the question arose as to whether one cover crop is superior to another in its effect on the productivity of the soil. In a current experiment three different winter crops are being compared to determine their influence on cultivated crops during the growing season. Sweet corn is grown during the cultivated season. The 1947 yields and 3-year average yields of sweet corn following the indicated cover crops are shown in the following table.

Sweet corn yields following different winter cover crops

Winter cover	No. 1 ears per acre	
	1947	1945-47 average
Rye	9600	9120
Ryegrass	7200	7930
Ryegrass and vetch	11305	11330

"Runoff and soil loss measurements from these plots were not made but each of the crops made sufficient growth to provide satisfactory winter protection. They differed considerably, however, in their influence on the following sweet corn crops as is indicated by the yield data."

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**All research work of the Soil Conservation Service is in cooperation with the various State Experiment Stations.

Effect of Freezing on Soil Structure - C. S. Slater, College Park, Maryland.-"A preliminary examination of the effect of frost on soil structure indicates that freezing a soil tends to destroy soil aggregates. The effect is marked on bare soil, and is decreased by mulch.

Percentage of Water-Stable Soil Before and After Freezing

Crop	Before freeze	After freeze	
	Check	Bare	Mulched
Continuous corn	41.6	23.0	40.2
Corn, manured	40.6	19.8	30.0
Corn, 2 year rotation	46.2	17.3	28.8
Corn, 3 year rotation	67.5	47.6	54.8
Sod	85.2	82.9	--

Crop Yield Index for Sandy Loam Farms Versus Sand Farms - H. O. Anderson, LaCrosse, Wisconsin.-"A study of 21 'on the farm' trainee records in the Adams County Soil Conservation District indicates that the nine G.I.'s on sandy loam farms have a considerable advantage over the twelve on the sandier soils in crop yields.

"The crop yield index for the former averaged 117 (average of all farms equal 100) as compared with 83 for the latter. The greatest disadvantage in crop yields of those on the sandier soil was in corn and small grain and the smallest in soil conserving crops such as hay.

Table 1.--Yield of crops and crop yield index 1947, 9 sandy loam farms and 12 sand farms

	9 sandy loam farms	12 sand farms
Corn silage, tons	6.6	3.8
Corn, bushels	31.0	20.0
Corn yield index	125.0	78.0
Oats, bushels	33.0	19.0
Wheat, bushels	11.1	3.0
Rye, bushels	11.9	8.5
Small grain yield index	118.0	81.0
Alfalfa, tons	1.6	1.2
Clover, tons	1.3	1.6
Clover & timothy, tons	1.8	1.2
All tame hay, tons	1.52	1.28
Tame hay crop yield index	105.0	92.0
Potatoes, bushels	46.0	32.0
Crop yield index, all crops	117.0	83.0

"A change to better rotations is needed on most if not all of these farms. Rotations consisting of from at least 60 to 75 per cent soil conserving crops are recommended by the Wisconsin Agricultural Experiment Station and the Soil Conservation Service for land such as is found on most of these farms. Cropping systems average approximately a three-year rotation for both groups of farms. An increase in soil conserving crops (hay and rotation pasture) should be desirable, particularly, on the sandier soil.

Table 2.-- Crop acreages, 9 sandy loam and 21 sand farms, G. I. trainees, Adams, 1947

	9 sandy loam farms	12 sand farms
Corn	25.4	22.4
Small grain	34.8	24.2
Hay and rotation pasture	33.9	27.9
Miscellaneous crops	.6	1.7
Row crops, per cent	27.5	31.6
Small grain, per cent	36.7	31.8
Hay & rotation pasture, per cent	35.8	36.6

"Operators of the sand farms are handicapped by the low yields per acre. The cost of producing a ton of hay or a bushel of grain is quite high when yields are so low. Previous studies in this area indicate that machinery and power costs are about the same per acre for the sand farms as for the sandy loam."

Soil Moisture Higher than Usual in Eastern Wyoming Range Land - O. K. Barnes, Laramie, Wyoming.-"The soil moisture data collected in the fall on rangeland across eastern Wyoming shows the following moisture percentages.

	Fall 1947				Averages				No. Yrs.
	1 ft.	2 ft.	3 ft.	Ave.	1 ft.	2 ft.	3 ft.	Ave.	
Archer	17.37	7.18	5.66	10.07	11.75	7.90	5.62	8.42	9
Douglas	14.78	7.45	6.38	9.54	10.81	7.08	6.02	7.97	5
Gillette	14.14	7.11	5.78	9.01	11.46	8.83	5.85	8.71	5
Sheridan	15.56	12.88	10.43	12.96	12.69	10.97	10.19	11.28	5

"These data are reported as a record. When the 1947 forage yields are determined they will be included with the soil moisture data. These soil moisture percentages show that the soil moisture that went into the winter of 1947 was well above average. In only one year out of the nine has it been higher at Archer: At Gillette the soil moisture in the top foot was slightly higher in 1946 but lower every other year: At Douglas and Sheridan the soil moisture in the top foot was higher this fall than any previous year. The soil moisture in the second and third feet was about average this past fall as compared to previous years. This level of moisture would provide considerable early forage growth even with deficient spring precipitation."

Runoff in Relation to Management of Wheatland - Glenn M. Horner, Pullman, Washington.-"Precipitation continued heavy during February, with a total of 4.01 inches, which is the third highest in the past 56 years at Pullman. This made the total for the period since September 1, 1947, 21.10 inches, the largest amount recorded during any season at Pullman, and 7.51 inches above the average. Two storms occurred in February that resulted in flood conditions in the Palouse. These storms and the one in January, which also caused high runoff, are summarized below.

Date	Duration of storm	Total amount	Maximum intensities for 15 min.	30 min.	1 hour	12 hours
	(hours)	(inches)	(Inches)			
Jan. 5-7, 1948	40	1.97	0.20	0.18	0.16	0.09
Feb. 21-22, 1948	14	0.87	0.20	0.16	0.11	0.07
Feb. 25-26, 1948	19	1.63	0.20	0.20	0.18	0.11

"Flood conditions on the Palouse River were intensified during the January flood by melting snow in the upper portions of the watershed, and during the February floods by frozen soil on slopes with a northern exposure. The flood stage on February 26 was the highest since 1910.

"Runoff data from control plots show that such factors as vegetative cover, crop rotations, and tillage operations had a marked influence on water losses. These plots have a southern exposure, so the effect of the above treatments were not masked by frozen soil during the three major storm periods. Total water losses for the season are given below.

"These results show that good conservation practices would have significantly reduced the flood damage, even though the runoff from some of these conditions would have been greater on a watershed basis than on the small control plot basis, because of frozen soil on a portion of the watershed and also because of ground water flow.

Cover Condition	Previous Crop or Treatment	Water Loss (inches)
Crop Rotation Plots		
Wheat stubble	(Untilled stubble land)	0.1
Alfalfa and grass	(2 and 3-year old stands)	0.1
Sweetclover and grass	(1 year old stand)	0.1
Winter wheat	Alfalfa and grass	0.7
Winter wheat	Sweetclover and grass	1.1
Winter wheat	Hubam clover	1.4
Winter wheat	Peas as green manure	1.6
Winter wheat	Peas for seed	1.8
Winter wheat	Summer fallow	3.2
Stubble Utilization Plots		
Winter wheat	Fallow with 2-ton straw mulch	0.9
Winter wheat	Fallow with 1-ton straw mulch	2.6
Winter wheat	Fallow with 2-ton straw plowed under	4.6
Winter wheat	Fallow with 1-ton straw plowed under	4.8
Winter wheat	Fallow with straw burned and plowed	5.0

Effect of Strip Cropping on Winter Runoff - Orville E. Hays, LaCrosse, Wisconsin.-"The rain of February 27 and 28 amounting to 1.34 inches fell on varying depths of snow and frozen ground. Measurements on the Control Plots show that where the soil was covered with snow, most of the rain was absorbed, resulting in very low amounts of runoff. Where the soil was bare, most of the rain ran off. Plots that were partially covered with snow lost runoff in amounts exceeding the rainfall. It has been our observation in the past that there is more runoff from hay land in the winter than from plowed land. During this storm there was not much difference in runoff between the two, probably because the plowed land did not thaw more than an inch or two.

"We have been interested in determining the ability of strip cropping to control erosion and runoff during winter and spring conditions. Runoff from duplicate plots at the Hundt farm show that strip cropping during this rain greatly reduced the amount of runoff. Although the soil loss data are not yet available, it is thought that the loss from this storm was quite low."

Effect of Strip Cropping on Runoff
Storm of February 27 - 28

Treatment	Runoff, Inches
Strip cropped	0.96
Plowed sod	1.42
Plowed corn	2.06

Fall Tillage Destroys Snow-Holding Capacity of Stubble - Torlief S. Aasheim, Bozeman, Montana.-"While observing the tillage plots near Froid with the District Supervisors, Work Unit personnel and the County Agent a very striking observation was made. The snow in stubble strips next to subsurface tilled fallow was nearly white, there was hardly any soil on top of the snow. In the stubble strips next to all other types of fallow the snow shaded from grey to black. This observation was conclusive and striking evidence to all of us that stubble mulch fallow is effective in controlling wind erosion. High winds have not been common in the area this winter but considerable soil movement has occurred on some fields.

"Another observation of interest was this, stubble fields which were disced last fall had hardly any snow cover. In fields where the stubble was unmolested last fall the snow cover ranged from stubble depth adjacent to bare fallow to about half that much on the leeward side of stubble strips. Destruction of snow holding capacity of stubble by fall tillage is one reason this practice should be discouraged. It has been evident from moisture samples taken at Froid that snow cover is important in adding moisture to the soil."

Soil and Water Losses in Relation to Cropping Practices - George W. Hood, Batesville, Arkansas.-"The table sums up the results of the soil and water losses for the past year and gives some interesting figures. You note the rainfall for the year was light and the number of storms on which runoff occurred was only about one half as many as usually occur in a normal year. However, the losses still produce figures that emphasize the value of conservation practices, especially on strip cropping.

Rainfall, Runoff and Soil Loss per Acre
1947

Crop and Treatment	Rainfall	Runoff	Soil Loss
		Inches	Tons
BAXTER SOIL			
Continuous cotton, with the slope 90' rows	34.53	6.881	4.15
Continuous cotton on the contour	34.53	3.084	2.51
3 year rotation of cotton, corn and oats on the contour with vetch and lespedeza turned under as soil improving crops, different crop on soil each year.	34.53	4.839	1.32
OZARK SOIL			
Continuous cotton, with the slope 200' rows	34.53	6.370	10.76
3 year rotation of cotton, corn and oats on the contour with vetch and lespedeza turned under as soil improving crops, in strips approximately 32 feet wide	34.53	1.781	0.56

"The soil loss from continuous cotton with the slope on Baxter soil was 4.15 tons per acre. The loss from continuous cotton grown on the contour was 2.51 tons. In comparing the non-conservation practices with the 3 year rotation of cotton, corn and oats plus soil improving crops we find the soil loss for the conservation practices to be only 1.32 tons as contrasted with 2.51 and 4.15 tons.

"The difference in the loss of the several practices on the Ozark soil is still greater. The soil loss from continuous cotton planted with the slope was 10.76 tons per acre. The loss from strip cropping arranged in a three year rotation and planted on the contour, together with soil building crops was only 0.56 tons per acre. This is about 1/20 the loss that occurs when the crop is planted with the slope."

Effects of Contouring on Soil Loss - Soybeans - Corn - C. A. Van Doren, Urbana, Illinois.-"Soybeans when planted in rows on the contour have continued to be more effective than corn in reducing soil losses. With corn for a three year period, soil losses from the contoured plots were 0.61 of the losses from the non-contoured plots. With soybeans the ratio of losses was 0.28. Even small seedlings are effective in reducing soil losses because of the close spacing in the row. The plants reduce the rate of runoff and cause deposition of soil adjacent to and below the soybean row. Drilled corn planted at a heavy rate has open spaces of 9 to 12 inches in the row between plants. Water flows practically uninterrupted in these open spaces until ridges are developed through cultivation.

Effect of Contour Farming on Soil Losses - Agronomy Farm - Urbana, Illinois
Crop Years (1941 - 1947)

Crop	Year	Soil Losses		Ratio
		Contour Lbs/ac.	Non-Contour Lbs/ac.	Contour ÷ Non-Con.
Corn	1947(1)	3978	6244	0.64
	Average (1945-47)	3566	5857	0.61
Soybeans	1947(1)	2738	7305	0.37
	Average (1945-47)	1555	5482	0.28

(1) April through December 1947

Heavy Grazing of Sod in Rotation Increased Soil Loss from Cultivated Crops - "Grazing management of pasture and meadow land can influence soil losses from cultivated crops in a rotation. This fact was confirmed by soil losses from corn plots at Dixon Springs in 1947. Two plots which had been treated and seeded to a grass-legume mixture in 1946 were plowed for corn in 1947. One plot had been closely-grazed and the other moderately-grazed through the 1947 season. The plot which had been severely-grazed lost 5.0 tons per acre of soil, while the plot moderately-grazed lost only 3.0. With one exception all storms during the growing season had low intensity which explains the low soil losses secured on these plots.

Effect of Previous Grazing Management on Soil and Water Losses During Corn Production - 1947

Previous Grazing	Water Losses Inches	Soil Losses Tons per acre
Severe	1.80	5.0
Moderate	1.63	3.0

The Use of Fertilizer in Conservation - Dwight D. Smith, Columbia, Missouri.-"Some material not previously covered in the monthly reports is as follows:

"Fertilizer used on the corn plots for the first time during 1947 offset the yield depression caused by the lack of rainfall during July and August (22% of normal). With an average of 450 pounds per acre of 10-20-20 fertilizer in a combination band and plow sole application, a yield practically equal to the average of the same plots without fertilizer during the previous 6-year period was secured. Without fertilizer the 1947 yield was only 27 percent of the 6-year average yield without fertilizer. When the equivalent of 200 pounds per acre of 10-20-20 fertilizer was used in addition to plowing under sweet clover as green manure, the 1947 yield was 29 percent greater than the 6-year average yield for sweet clover under without fertilizer. Yields were as follows:

Sequence	1947 Treatment	1947 Corn Yield	1941-46 Average Treatment	1941-46 Average Corn Yield
		bu/ac		bu/ac
Corn after oats	None	6.8	None	25.6
Corn after 1 yr. corn	200 lbs/ac 10-20-20	22.4	None	29.5
Corn after grass-clover meadow	450 lbs/ac 10-20-20	29.8	None	30.9
Corn after sweet clover under	200 lbs/ac 10-20-20	42.0	None	32.6

"Oat seeding in 1947 was delayed until after May 1 because of above-normal rainfall during March and April. Fertilized oats averaged 24.5 bushels per acre, or 73 percent of the average for fertilized oats during the preceding 6-year period. Unfertilized oats yielded 10.4 bushels per acre in 1947, or 53 percent of the average for unfertilized oats during the preceding 6-year period. Here again fertilizer tended to eliminate a yield depression caused by adverse weather conditions.

"The use of both lime and fertilizer on soybeans has resulted in a yield increase 52 percent greater than the sum of the increases when either of the amendments was used separately. These results are 6- year averages for the period 1942-47 from contour planted soybeans in a 3-year rotation of soybeans, rye, and meadow. The soil was eroded Putnam silt loam of low fertility. Without fertilizer or lime the average yield was 12.4 bushels per acre. The use of 3 tons per acre of lime increased the yield 1.4 bushels per acre. Fertilizer, 150 pounds per acre of 0-20-10 in bands, without lime increased the yield 1.4 bushels per acre, but with lime the increase was 3.0 bushels per acre, making a total yield increase of 4.4 bushels per acre from a combined treatment of the lime and fertilizer. This trend has been in evidence each of the six years. Similar increases were secured when 300 pounds per acre of the same fertilizer was placed on the plow sole without the band application.

"The 4.4 bushel increase in bean yield by the use of both lime and fertilizer represents an increased return of $18 per acre at present bean prices from an investment of $4.40 per acre. This is a return of more than $4 for each dollar invested in soil treatments."

Effect of Tillage and Cropping Practice on Protein Content of Wheat - F. L. Duley, Lincoln, Nebraska.-"Protein determinations were made on 1947 wheat samples in cooperation with Mr. J. C. Swinbank, Secretary Nebraska Grain Improvement Assocation. The results are shown in the table on the following page.

What is the Value of Straw? - "A question that is being asked very frequently now is 'What is the value of straw?' Industrial research is being done on methods of utilizing straw for various manufactured items. In calculating the value of straw on the land on the basis of our experiments in a corn, oats, wheat rotation at Lincoln, we may have a partial answer to this question. As an average of 9 years, the increased yield where crop residues were plowed under over land where the residue was removed or burned was 2.6 bushels of corn, 3.9 bushels of wheat, and 3.2 bushels of oats. If we figure corn worth $1.00 a bushel, wheat $1.50, and oats $0.75, the value of the

increase would be $10.85. This would be an average annual increase for the use of the residue of $3.62. When calculated on the basis of tonnage of residue, the average yield of residue on the plowed land was 4.1 tons total for 3 years, which would return a value of $2.65 per ton of residue. In addition to the increased value of the crops, the loss of soil on the land where the residue was removed was 7.0 tons per year. On the land that was subtilled it was only 1.5 tons. From all information available, it would be impossible to maintain the fertility of a soil losing 7 tons of soil per acre per year."

Summary of Protein Results on Wheat - 1947

	% of protein on	
	Plowed	Subtilled
Field 23 - Wheat after oats after oats	12.5	13.0
Field 23 - Wheat after oats after sweetclover 2 years	16.4	16.5
Field 26 - Wheat after sweetclover 2 years	15.9	15.5
Field B-I - Wheat in bromegrass rotation	11.4	11.4
Field 27 - Partridge pea land	--	12.5
Rotation - Corn, oats, wheat	11.1	10.9
Plowed - no residue	10.6	--

The effect of Contour Cultivation and Terraces on the Conservation of Runoff Water and Crop Yields, Wheatland Conservation Experiment Station at Cherokee - Harley A. Daniel, Guthrie, Oklahoma.-"Where all cultivation was conducted with the slope (Table 1) the lowest amount of runoff was from the mulch plots and the highest from the listed. During heavy rains the dams in the furrows of the plots basin listed with the slope often broke and this may account for the runoff being higher from these plots than that from the plowed land. But both listing and basin listing greatly reduced runoff water losses when listing followed the contour. In fact during the last six years contour cultivation reduced the average amount of runoff from the four methods of tillage 24.2 percent. Even though this is an outstanding saving of moisture, observations on the watersheds show that contour cultivation alone is not sufficient to control erosion on land slopes over 1.5 percent. On steeper slopes, a combination of terraces and contour cultivation is needed. How terraces help hold water is illustrated by the fact that in this test the combination of level terraces and contour cultivation conserved an average of 43.2 percent more water than land cultivated with the slope. The amount of soil lost in the runoff has not been recorded from studies at Cherokee. But results on the station at Guthrie show that terraces also greatly reduced soil losses and prevented severe erosion.

"The first and second year after these terraces were built the yield of wheat on the terraces and contour cultivated plots was less than that from those cultivated with the slope. But beginning with the third year, apparently after nature had time to adjust soil conditions in the disturbed portion of the ridges and channel, the yields have been higher on the terraced and contour cultivated plots. Although the rainfall for the 1945 crop year was well distributed and 8.6 inches above normal, terraces and contour cultivation increased the yield an average of 1.3 bushels per acre. With the exception of the first year contour cultivation alone also increased crop yields. The effect of the tillage methods and terraces on crop yields will be given in a later report."

Table 1.--Effect of tillage method, contour cultivation and terraces on runoff water from deep, permeable soil; Cherokee, Oklahoma[1/]

Method of Tillage	Percentage of Rainfall Lost in Runoff			Percentage of Runoff Saved By:	
	With Slope	Contour	Terraces(2) & Contour	Contouring	Terracing & Contouring
Stubble mulch	12.0	11.1	6.9	7.5	42.5
Plowed	12.8	11.0	7.4	14.0	42.2
Listed	14.4	9.4	8.2	34.7	43.1
Basin listed	13.8	8.5	7.6	38.4	44.9
Average	13.2	10.0	7.5	24.2	43.2

1/ Results for crop year (July 1 to June 30). Six-year average 1942-47. Average annual rainfall 24.6 inches.
2/ Short level terraces with one end open.

Table 2.--Effect of Contour cultivation and terraces on wheat yields at Cherokee, Oklahoma[1/]

Year	Wheat Yields (Bushels per acre)			Difference in Yield (Bushels per acre) Due to:		Precipitation[3/]	
	Cultivated With Slope	Cultivated on Contour	Terraced and Cultivated on Contour[2/]	Cultivating on Contour	Terracing & Cultivating on Contour	Total Annual Inches	Departure from Average Inches
1942	16.0	15.5	14.1	- 0.5	- 1.9	30.0	+ 4.4
1943	9.2	9.9	8.0	0.7	- 1.2	20.3	- 5.6
1944	17.7	19.2	19.4	1.5	1.7	20.4	- 5.5
1945	23.2	24.6	24.5	1.4	1.3	34.3	+ 8.6
1946	21.0	24.0	23.8	3.0	2.8	23.7	- 2.1
1947[4/]	18.8	19.5	20.0	0.7	1.2	24.6	- 1.2
Average	17.6	18.8	18.3	1.1	0.7	25.6	- 0.3

1/ Data compiled from averages of stubble mulch, plowed, listed and basin listed plots.
2/ Short level terraces one end open.
3/ Based on Weather Bureau record in Cherokee, Oklahoma, since 1915.
4/ The rainfall at seeding time was below the average, but above the average during the spring growing season.

DIVISION OF DRAINAGE AND WATER CONTROL

Hydrologic Studies - L. L. Harrold, North Appalachian Experimental Watershed, Coshocton, Ohio.-"Snowfall in January and that of February 4 and 12 (0.28 inch) remained on the ground until February 13. The snow depth of 8 inches amounted to 1.25 to 1.50 inches of water. Soil in wheatland was frozen 2 inches deep. There was practically no frost in grass or wood areas. The rainfall intensities early in the storm of February 13 (1.54 inches) were low and the water was absorbed by the snow. The accumulated rainfall before runoff started for the storm of February 13 is given for selected watersheds in the following table:

Watershed No.	Soil drainage	Crop	Accumulated rainfall before runoff began	Remarks
109	Well drained	Meadow	0.84	
123	Slowly permeable	Meadow	.18	
131	Well drained	Woods	.74	
111	Fair	Wheat	1.02	Tilled 9 inches deep for corn, May 1947
113	Fair	Wheat	.69	Plowed 7 inches deep for corn, May 1947

"Runoff began after the topsoil became saturated. Pores in the 7-inch topsoil filled from melting snow and low intensity rainfall. After this, infiltration rates are controlled by percolation of water into the subsoil. The deeper tillage last May for corn on watershed No. 111 apparently had the effect of increasing the depth of topsoil. Runoff on this deep-tilled watershed started 1-1/2 hours after the beginning of runoff on watershed No. 113, plowed in the conventional manner. A total of 0.33 inch more water was absorbed in this period.

"Although the deep-tillage operation was performed in May 1947, there was some residual effect in September - at corn harvest time. This is indicated in the following soil-moisture table determined from laboratory analysis of field samples:

Tension	Soil moisture on watershed	
	No. 111	No. 113
cm.	% of Volume	% of Volume
0	47.0	47.0
10	40.5	42.8
20	38.5	40.8
40	36.5	38.6
60	35.2	37.5
80	34.8	36.9

"The possibilities for reducing runoff by deeper tillage seem promising. The 1947 operations were made in wet soil. It is expected that better results may be obtained by deep tillage in a drier soil."

Hydrologic Studies - John A. Allis, Central Great Plains Experimental Watershed, Hastings, Nebraska.-"In regard to the recent paper on 'Rates of Runoff for the Design of Conservation Structures in the Central Great Plains of Nebraska and Kansas', the area of application map was marked tentative pending a definite outline of the area by the soil scientists. On February 9, Mr. Claude Fly, Soil Scientist from Manhattan, Kans., examined the soils on the Central Great Plains Experimental watershed and outlined the area of application in Kansas which is representative of this project in regard to runoff characteristics. The area outlined covers approximately 28 counties with an area of about 18,000 square miles. On February 12, Mr. Lloyd Mitchell, Soil Scientist from Lincoln, Nebr., tentatively outlined the area of application in Nebraska, which includes about 28 counties and about 15,000 square miles. In other words the area of application is roughly 33,000 square miles and data collected at this project is applicable without correction over most of this area. Although this comprises a fairly large area, runoff data are needed for adjoining soil types and in different rainfall belts, so that corrections could be applied making maximum use of the data being collected."

Hydrologic Studies - George Crabb, Jr., East Lansing, Michigan.-"Precipitation amounted to 1.76 inches for the cultivated watersheds, 1.37 inches for the stubble-mulch plots, and 2.14 inches for the wooded watershed.

"There were four runoffs during this month on Watershed 'A', occurring February 17 with a loss of 4.8847 inches of water, February 22 with a loss of 0.0029 inch, February 22-25 with a loss of 0.6962 inch, and February 27-28 with a loss of 0.7411 inch. There were three runoffs on Watershed 'B' during this period: February 16-19 with a loss of 1.6994 inches of water, February 23 with a loss of 0.0180 inch, and February 24-28 with a loss of 1.4156 inches. There were no runoffs on the wooded watershed. These runoffs were occasioned by the usual February thaws and consisted primarily of melted snow from the watersheds. Following the thaws the temperature went back to its accustomed place in the lower end of the thermometer.

"On Sunday, February 15, the project supervisor received a call from Mr. K. A. Stevenson, of the Milwaukee office, United States Army Corps of Engineers, for assistance in locating snow courses in relation to his office study of the Grand and Kalamazoo Rivers for flood-control purposes. The data on hand were made available, and several profitable hours were spent with Mr. Stevenson in discussion of flood-control problems and soil-conserving matters. A report of the visit was made to Operations, and a reply received which indicated cooperation was strong between the two agencies."

Hydrologic Studies - R. W. Baird, Waco, Texas.-"Total rainfall for the month was 1.96 inches, which is slightly less than normal. There was measurable rainfall for each of the first 8 days of the month and 5 days the remainder of the month. Some of the precipitation occurred as freezing rain 0.14 inch on February 12. At the end of the month the soil was quite wet to a depth of 18-24 inches but was still very dry below this depth. The freezing rain almost completely killed fall planted Hubam clover but there was little damage to other winter cover crops.

"Crop yields for 1947 have been computed and summarized. For 1947, areas with conservation practices had 18.8 percent more cotton, 17.0 percent more corn, and the same yield of oats as similar areas with ordinary farm practices. The summary of yields was as follows:

Crop	Practices	No. of fields	Total acreage	Ave. yield per acre
Cotton	Conservation	18	64.9	266.8 lbs. lint
	Ordinary	21	127.7	224.5 lbs. lint
Corn	Conservation	11	46.4	22.20 Bu.
	Ordinary	21	92.5	18.98 Bu.
Oats	Conservation	10	47.7	20.67 Bu.
	Ordinary	9	58.9	20.51 Bu.

Runoff Studies - N. E. Minshall, Madison, Wisconsin.-"At Fennimore precipitation was 2.17 inches which is more than twice the normal for February. Most of this was in the form of rain on the 24th, 27th and 28th. Temperatures were above freezing for the period of the 15th to the 19th, during which time most of the snow blanket melted and appeared at the stations as runoff, leaving the ground bare at the end of this period. The total runoff from melting snow varied from 0.75 to 0.98 inch. Temperatures were also above freezing during the period of the 23rd to the 28th. Precipitation during this time, all in the form of rain, was 1.89 inches. There were no high intensities but the frozen soil produced about 100 percent runoff from these rains. There was considerable sheet erosion on the plowed fields due to the thawing of the surface layer prior to the actual precipitation. Maximum rates of runoff from the rainfall of the 27th were about 0.30 inch per hour from all the areas. The temperatures for the month were about normal, with a maximum of 48 degrees on the 17th and a minimum of -13 on the 8th.

"Precipitation at Edwardsville for February was 1.21 inches as compared with a normal of 2.10 inches. All of this was in the form of snow with the exception of 0.51 inch as scattered light showers on the 27th. The snow blanket melted and appeared as surface runoff during the period of the 15th to the 19th when the temperatures rose to above 55 degrees on four successive days. Total runoff for this period was about 1 inch. Temperatures were also above freezing from the 23rd through the 28th. The ground was free from frost before the 27th and so this rainfall produced only a moderate amount of runoff. Temperatures varied from a maximum of 64 degrees on the 18th to a minimum of -4 on the 9th, with an average for the month of 28 degrees, which is about 5 degrees below normal.

"The question was raised by Mr. Reese, Hydraulic Engineer on Flood Control, and passed on to me by the Regional Engineering Section, as to whether the total flood flow in inches for a storm should not be reduced as the size of the drainage area increases from 50 to 2,000 acres, due to the reduction in average rainfall intensities over the larger areas. Because of the variation in crop cover on all watersheds under my supervision, a study of the runoff from individual storms was of no value. I therefore compared the precipitation of individual gages for selected storms with the average precipitation on the watersheds. In the case of Fennimore areas, I found the total rainfall per storm to be somewhat higher on the 330 acres than on the 171 acres. This was no doubt due to the fact that the gages on the smaller areas were in more exposed locations, which resulted in a reduction in catch due to the effect of higher wind velocities. The results of individual gages, of course, did show slightly higher than the average for any of the watersheds. This variation, however, was less than 10 percent. It is my opinion that this reduction in rainfall intensity as the size of the drainage area increases will perhaps be considerably offset by larger percentage of roads and impervious areas, steeper topography and more severe erosion on the larger areas."

Hydraulic Studies - F. W. Blaisdell, Minneapolis, Minnesota.- "The closing discussion of the paper, 'Development and Hydraulic Design, Saint Anthony Falls Stilling Basin', was complete except for final typing. The discussions of the paper were of a character that required considerable study before the closing discussion could be written. The discussion should serve to evaluate this stilling basin design for future readers of the paper.

"About 8 man-days were spent in reviewing a design for the stilling basin at the Stiles Hydroelectric Development of the Oconto Electric Cooperative, Oconto Falls, Wis. This review was authorized by Mr. L. A. Jones at the request of Mr. C. H. Jennings of the Rural Electrification Administration. We could not approve the designs submitted by the consulting engineers. The tailwater at this dam under flood conditions is

so high that stilling basins using the hydraulic jump to dissipate the energy cannot be expected to function properly. Experience here at the laboratory indicates that model studies will be required to develop a satisfactory and safe stilling basin."

Sedimentation Studies - L. C. Gottschalk, Washington, D. C.- "A conference was held during the month with representatives of the Cartographic Division to discuss methods of producing an adjusted multiplex mosaic of Springfield Reservoir, Springfield, Ill. A detailed sedimentation survey will be made of this reservoir this summer in cooperation with the Illinois State Water Survey Division. The mosaic will eliminate mapping the shore line of the reservoir, a necessary operation which consumes considerable time of the field men. The new method, as well as expediting field work, promises to be more accurate than mapping by plane-table methods and may be adopted eventually for all reservoir sedimentation surveys."

Drainage Studies - M. H. Gallatin, Homestead, Florida.-"Rainfall for the period varied. At the corner of Roberts and Avacado 1.70 inches were recorded while at the corner of Mowry and Redland 1-1/2 miles to the southwest 4.89 inches were recorded. Our other gages scattered throughout the area varied from 2.5 to 3.5 inches. The major portion of the rainfall for the month fell during two periods, January 11-14 when two rains of over 1 inch were recorded and light general rains occurred from the 21-24. Well readings for the period showed an increase in our water table to the 1-19-48. The greatest gain occurred in the northern end of the area covered by the Eureka Drive profile, the northern end of the Redland road profile and the western end of the Mowry St. profile. Gains in the northern end were over .6 of an inch while in the coastal area the average gain was less than .2 of an inch. While we had an increase in water table to January 19 our readings show a loss in water table elevation for the month 12-29-47 to 2-2-48 ranging from -.36 hundreths of a foot in the coastal area to -.89 hundreths of a foot at the northern end of the area. Our average water table at the end of this period was approximately one foot higher than the water table a year ago. The average loss per day is about one-half of what it was for this period last year.

"As a result of our nitrate-leaching studies, several of our leading grove caretakers have revised their fertilizing program. In the past the usual practice has been to apply fertilizer every 90 days in rather large quantities. We found that applications on this basis would not last, so on the basis of the past year's work these men have split up their yearly application and are now applying a prorata portion each month. While as yet we do not have sufficient data to reduce application rates, the shorter application cycle has resulted in being able to maintain a more uniform level. Because of storm damage the past 2 years we haven't been able to obtain production checks on the various areas we are working on. The physical appearance of the trees seems better in the areas on which the nitrate level is held at a more or less constant level. On the basis of our work the past year, two of our cooperators using organic-type nitrogen fertilizers have cut out one

application of fertilizer saving between $8,000 and $10,000. Our work to date indicates that when using organic or organic-type nitrogen the cycle can be lenghtened where as when using more readily available types the level cannot be maintained on a 90-day cycle, and in order to maintain a good level the cycle should be shortened to 30 days.

"The application of uramon through overhead irrigation was started the first of February. Application rates were as follows: 1/2, 3/4, and 1 pound applied as broadcast per tree.

"The following is a general summary of conclusions for this year's operation in connection with our water-control plot:

1. To adequately control the water on our marl soils and to remove the heavy rains, pumping capacity to remove at least 3 acre-inches in 24 hours is essential.
2. Tapping of potholes actually increases the pumpage without lowering the ground water table. During the past season one large and one small pothole was tapped. The net result is that normally we could have cut our pump after clearing or lowering the water in the ditch but we had approximately 100 g.p.m. flow from these potholes so had to keep the pump operating at a low speed to hold our water in the ditches down, so the tapping of these has actually increased our pumping.
3. Shallow internal drainage is necessary and essential to fast removal of water.
4. We found that our shallow ditches 3 feet deep and 3 feet wide would not bring our water to the pump fast enough."

Drainage Studies - T. W. Edminster, Blacksburg, Virginia.-"On February 17 and 18 the Project Supervisor attended a permeability field review in the vicinity of Brunswick, Ga. Representatives from each of the Southeast states studied in detail the soil permeability and drainage problems involved in reclaiming the abandoned rice marshes in that area. The project supervisor reported on the initial results achieved in comparing the 3-inch alloy cylinders with the 4-inch stainless steel cylinders that have previously been used in Virginia. The comparisons being made have been discussed in previous reports. Briefly, however, the results are as follows:

> 3-inch jacked versus 3-inch driven, 10 horizons and three soil types being sampled under only one set of moisture conditions showed no significant difference under percolation without tension. However in water drained in 15 minutes, jacking showed a higher degree of drainage to the extent of being significant to the one percent level. Water drained in 15 hours showed no significant difference. Volume weight and field moisture capacity showed no significant difference.

> Comparison of the 3-inch jacked versus 4-inch stainless steel cylinders jacked on three soil types and six horizons showed a higher rate of percolation on the 4-inch cylinders significant to the one percent level, whereas in water drained in 15 minutes and in 15 hours was greater for the 3-inch cylinders and significant to the one percent level. No difference appeared on volume weight and field moisture capacity.

"These are, of course, preliminary results and some of the conflicting relationships shown in the above comparisons will undoubtedly be eliminated when the increased population together with varied moisture conditions, soil type, texture, and structure are taken into account."

Supplemental Irrigation Studies.- James Turnbull, Lake Alfred, Florida.-"February was a dry month with only 0.55 inch of rainfall recorded at the experimental plots. Irrigation was not required, however, since there was adequate soil moisture.

"Both the water table and lake level dropped during the month but at the end of the month both were still more than 4 feet higher than at the same time last year. A recording water-level gage has been installed in the lake so that variations in the lake level can be tied in more closely with rainfall and with fluctuations in the water table.

"In the Florida east coast district plans are progressing for the establishment of irrigation plots on the County farm near Fort Pierce. Tentative plot lay-outs have been made. It is doubtful if any irrigation work can be done before the start of the rainy season but we hope to have all arrangements completed so that work can be started as soon as is necessary after the rainy season ends."

IRRIGATION DIVISION

Irrigation Studies - George D. Clyde, Logan, Utah.-"Karl Harris reports a condition called 'piping' found on the Yalo Ranch in Yuma County. The condition is described as follows:

1. A deep outlet channel with more or less perpendicular banks.
2. A layer of soil somewhat above the bottom of the outlet channel which is relatively impervious compared to the soil above. (This tight layer causes a hydrostatic head to develop.)
3. The soil above the tight layer is fine and highly dispersed.

"When the lands nearest the bank of the channel are irrigated the water percolates to the impervious layer. A hydrostatic head is built up and the water moves along the tight layer to the outlet channel. At the outlet channel bank the highly dispersed soil sloughs off into the outlet channel and is carried away. As this sloughing works back, a hole develops and when it gets near enough to the surface a cave-in occurs. This type of erosion is working back across the fields. It is a vicious type of erosion because it works up from the bottom. Two other areas where this action is taking place are at Benson, Ariz. and near Preston, Idaho. There seems to be no known remedy. Experimental work is urgently needed.

"C. W. Lauritzen reports the publication of his article entitled 'Apparent Specific Volume and Shrinkage Characteristics of Soil Materials' in the February issue of Soil Science. Lauritzen reports further, 'There has been some concern as to the increased permeability of soil-bentonite mixtures through replacement of the exchangeable Sodium by Calcium and Magnesium. Tests extending over several months with two soil-bentonite mixtures, two salt solutions at two concentrations and tap water are summarized in the following table. It would appear that Calcium Chloride and Magnesium Chloride solutions tend to increase the permeability, the permeability will not be increased by most irrigation waters sufficiently to impair the effectiveness of the lining.

Table 1.--The influence of salt in percolating water on the relative permeability of soil-bentonite mixtures

Solution	Porous medium: Sandy Loam + 10% Henryvile Bentonite (ft. per yr.)	Porous medium: Sandy Loam + 10% Redmond Bentonite (ft. per yr.)
N/10 $CaCl_2$-	0.13	0.75
N/100 $CaCl_2$	.004	.07
N/10 $MgCl_2$	.04	.65
N/100 $MgCl_2$	.004	.09
Tap Water	.004	.009

"'Field trials of canal linings will be conducted in cooperation with the Richmond Irrigation Company. Approximately 1,800 feet of canal will be lined using thirteen different types of lining. Concrete reinforced and unreinforced, granite, reinforced and unreinforced, earth-bentonite mixtures, earth protected with concrete slabs, earth-bentonite mixtures and earth protected with gravel will be used.'"

D. K. Fuhriman reports, "During the month of February snow surveys made at the beginning and end of the month showed water supplies only slightly below normal for this time of year. This news was heartening to farmers who had begun to fear a water shortage because of sub-normal valley precipitation during January and February.

"The Utah Extension Irrigation School held the week of February 9-13 afforded an opportunity to discuss the water-forecasting program with irrigation leaders of the State. That these people are greatly interested in and dependent upon this information was evidenced by the questions and discussions on this topic. It is believed that participation in this type of program is very worthwhile and can provide a vital link with the irrigation people of the State."

J. H. Maughan reports, "The summary of data in connection with The Activities and Needs of Utah Drainage Districts shows that at the end of 100 years of Irrigation and one-third of a century of drainage in Utah the acreages irrigated, drained, and needing drainage are about as follows:

Irrigated area of the state	1,300,000 acres
Crop lands successfully drained	200,000 acres
Farm lands susceptible of reclamation by drainage	300,000 acres

"The following table gives a summary of drainage activities within and without organized drainage districts.

Table 1.--Summary of Utah Drainage Progress

		Areas in Acres	
1.	Land included in drainage districts.		204,000
2.	Land on which drainage districts installed drains..	154,000	
	a. Adequately drained by districts	92,000	
	b. Drainage not adequate	62,000	
	Total	154,000	
3.	Land on which districts failed to install drains because of costs and other reasons	50,000	
			204,000
4.	Land drained outside of organized districts by farmers	46,000	
	Total land drained	200,000	
	Total set up for drainage, within and without districts		250,000

Flow of Water in Concrete and Other Pipes - Fred C. Scobey.-"Some time was spent in locating research data on the accuracy of a Venturi meter (not Parshall's Venturi flume). Very little has been made available in publications. Apparently Venturis have been accepted at face value, since it is usual practice to check the meter recording device against the meter mercury columns. If these checked, it appears to have been assumed that the meter itself must be accurate. I believe this is not true. If the throat piezometer ring lies in a zone of possible cavitation then the differential head indicated is too much, indicating too much velocity head at the throat and too much flow. The possible zone of cavitation is due to the fact that the water, flowing toward the throat in a converging tube, does not press against the periphery of the throat properly but tends to leap clear of the throat walls and develop an excess of apparent velocity differential head. Thus, a meter may check within itself but still be inaccurate.

"Our computations indicate concrete pipe of greater capacity than I had believed possible. I hope for check-tests on the $11,000,000 concrete distribution system of the South San Joaquin Municipal Utility District, taking water from Friant-Kern Canal and just about ready for construction. When final plans are ready I expect to cooperate informally with

the U.S.B.R. in casting piezometer connections at proper locations in this extended system so we can verify the present day high grade of concrete pipe. It is hard to appreciate the fact that a relatively small group of farmers assume an 11 million dollar obligation for nothing but a pipe-distribution system. Such a thing could not have been visualized a few years ago. There will be no open lateral canals on this system. Large pipes (up to 63-inches diameter) divert from the Friant-Kern Canal and from there to the high point of each 160 acres the water will be within a pipe system, with control gates and pipe-measuring devices at each point of delivery to farmers."

Water Spreading San Joaquin Valley - A. T. Mitchelson, Dean C. Muckel, H. K. Rouse.- The ground-water tables throughout the entire San Joaquin Valley have been lowered to an alarming extent during the year ending October 1947. In the upper valley in "Basin Four" of the Arvin-Edison District, the water-table has dropped 16 feet, resulting in a pumping lift of 285 feet. Drops of more than 10 feet were recorded in the Lindsay, Tule River, Deer Creek and Lerdo districts. In 21 locations throughout the upper San Joaquin Valley measurements reveal an average drop of 7.6 feet in ground-water levels for the 12-month period ending October 1947.

A progress report containing a summarization of the effects of treatments given the Wasco and Winter Field test ponds was completed during the month. Since the work is not yet completed, the report is more or less informal and was distributed only to those of the cooperators who are active in the actual field program.

Water Requirements, Upper Colorado River Basin - Harry F. Blaney, Los Angeles, Calif.-"Evapo-transpiration losses by native vegetation in areas of high water table in Arizona, Colorado, New Mexico, Utah and Wyoming were computed for 46 stations. The following tabulation gives the tentative results for the growing season at several locations:

Location	Evapo-transpiration, native vegetation (tentative): Dense 1/	Medium 1/	Sparse 2/	Evaporation water surface reservoir (tentative)
	Inches	Inches	Inches	Inches
Chinle, Arizona	36.2	24.2	8.0	28.7
Kayenta, Arizona	42.5	28.3	7.8	33.6
Durango, Colorado	27.7	18.5	10.0	21.9
Grand Junction, Colo.	48.4	32.3	8.3	38.4
Bloomfield, New Mex.	38.9	25.9	7.8	30.8
Shiprock, New Mex.	41.7	27.8	7.3	33.0
Ft. Duchesne, Utah	30.6	20.4	5.7	24.2
Moab, Utah	46.9	31.2	8.0	37.1
Dixon, Wyoming	23.3	15.6	6.4	18.5
Green River, Wyo.	28.6	19.1	6.2	22.6

1/ High water table. 2/ No ground water available.

Water Requirement - Upper Santa Ana River - V. S. Aronovici, Pomona, Calif.-"Moisture withdrawal at 1/3 atmosphere tension curves were completed for fall deficiency stations 1 to 20. Again equilibrium moisture retained by the soil at this tension was below the observed field capacity. A special investigation was undertaken in an effort to secure further information on the effect upon the withdrawal curve by the thickness of the sample, permeability of the porous plates, and stratification of the samples. Duplicate samples of soil were placed on each of the two porous plates. All cylinders were two inches in diameter. The results are shown in the following table. 1:

Table 1.--Character of moisture withdrawal at one-third atmosphere tension for two soils 1/

Texture	Thickness	5 hours		24 hours		72 hours	
		Plate A 2/	Plate B 2/	Plate A	Plate B	Plate A	Plate B
	Inches	Percent 3/	Percent 3/	Percent 3/	Percent 3/	Percent 3/	Percent 3/
Sand	2	15.5	15.5	11.8	11.1	10.1	10.1
	1	16.5	13.5	12.3	9.8	10.0	8.2
	1/2	11.2	----	8.2	----	6.4	----
Silty clay loam	2	43.0	41.0	41.3	37.8	39.4	36.2
	1	45.8	42.5	43.2	40.3	41.0	38.5
	1/2	22.0	----	30.7	----	19.5	----
Silty clay loam over loam sand	2	25.8	23.2	22.8	19.7	20.0	18.2
Loam sand over silty clay loam	2	27.0	24.0	23.5	20.4	21.4	19.2

1/ Tension produced by vacuum under ceramic disc. 2/ Ceramic disc 11 inches in diameter and 1/4 inch thick. 3/ Percent moisture by weight."

Drainage of Irrigated Lands - San Fernando Valley - W. W. Donnan, Los Angeles, Calif.-"A farm-by-farm survey of irrigation wells in the San Fernando Soil Conservation District reveals that only a small percentage of the original 120 deep wells are used for irrigation. The rest of these wells have been filled in or abandoned. The well survey also disclosed the fact that a few of the wells are under artesian pressure and are flowing at the present time. When the locations of the artesian wells are plotted on a map they are found to be adjacent to the present high water table areas, leading to the conclusion that they possibly are a primary contribution to the high ground water. Observations of water levels in the 65 shallow piezometers in the area reveal a continued raise in the water table even though no appreciable rain has fallen on the area this rainfall year."

Drainage of Irrigated - Imperial Valley - W. W. Donnan, Los Angeles, Calif.-"Studies in both the laboratory and field on leaching of soluable salts in connection with drainage have been in progress. In reclaiming land by sub-surface tiling and ponding of water the salts are leached downward and out of the tile system. In determining the length of time necessary to pond the surface water it has been found that the permeability of the soil is the predominant factor. It has been revealed that the amount of water passed through the 5-foot profile seems to be the most important item. The leaching process tends to function from the top foot downwards in the soil profile. Thus in plots which were insufficiently leached, the top one or two feet showed a large decrease in soluable salts, but the third, fourth, and fifth foot zones revealed a corresponding increase in soluable salts."

Irrigation Studies - Dean W. Bloodgood, Austin, Texas.-"In the Eagle Pass Area a one-foot metal Parshall flume encased in concrete, had been installed and was functioning nicely. The flume will measure water for the irrigation of approximately 300 acres of land - mostly vegetables and cotton. The recorder had not been installed. At the time of our visit (the 26th), 6.25 second-feet of water was being measured by the flume and the water was being used for irrigating the land before planting. The irrigation season for the Eagle Pass Area is continuous throughout the year (a 365-day irrigation season) and several different crops are grown on the same land each year.

"A 5-foot rectangular weir was installed at a concrete drop on Lateral No. 22 and it was functioning nicely. Some minor adjustments will be necessary, however, before actual water measurements are undertaken. The flow recorder will be installed as soon as the stillwell and instrument shelter house have been constructed. This will be accomplished sometime during the first week of March. At the time of our visit (the 26th) the amount of water measured by the weir was 10.29 second-feet. The water was being used to irrigate some land in the Hopedale Section before planting. The weir will measure water on about 800 acres of land which is made up of several individual farms. The crop will consist mostly of different varieties of vegetables. At mr. H. A. W. Frick farm, a rain gage will be installed to record rainfall for the area. Mr. Frick is a director and secretary of Maverick County Water Control and Improvement District No. 1. It will be installed as soon as some protection is provided. The Richie Brothers will plant 365 acres of spinach.

"At the Jack Keisling farm near El Indio at the lower end of the District, a 9-inch metal Parshall flume has been installed to irrigate 125 acres of cotton. There will be some submergence at the beginning of the irrigation so two flow recorders have been installed to record the different heads for submergence. A rain gage has also been installed on the Keisling farm for rainfall records. Mr. Keisling plans to start the irrigation season for cotton on March 1. Cotton will be planted about the middle of March.

"Plans are also under way for the measurement of water near the intake of the Main Canal of the District (capacity about 1,500 second-feet--1,000 second feet for power purposes and 500 second-feet for irrigation) and for the measurement of all water returning to the Rio Grande from irrigations and other water losses. At one place near El Indio the losses to the District will amount to 25 to 35 second feet. The main canal is over 100 miles in length.

"Within the next year the District plans to spend $225,000 on a diversion dam, headworks, and main canal improvements, $12,000 for intercepting drainage, $217,763 for new lateral construction, $19,500 for new district headquarters, $101,370 for equipment and machinery, $277,065 for canal lining and pipe lines (Parshall flumes of other water measuring devices included), $12,000 for canal gates, $2,000 for right-of-way and other realty, $84,802 for engineering and construction contingencies, and $25,000 for incidental expenses. The above expenditure will be for new improvements."

4/12/48